EXHIBIT M

OMNIBUS BROWN DECLARATION

Proving Antitrust Damages

Legal and Economic Issues

Second Edition

ABA SECTION OF ANTITRUST LAW

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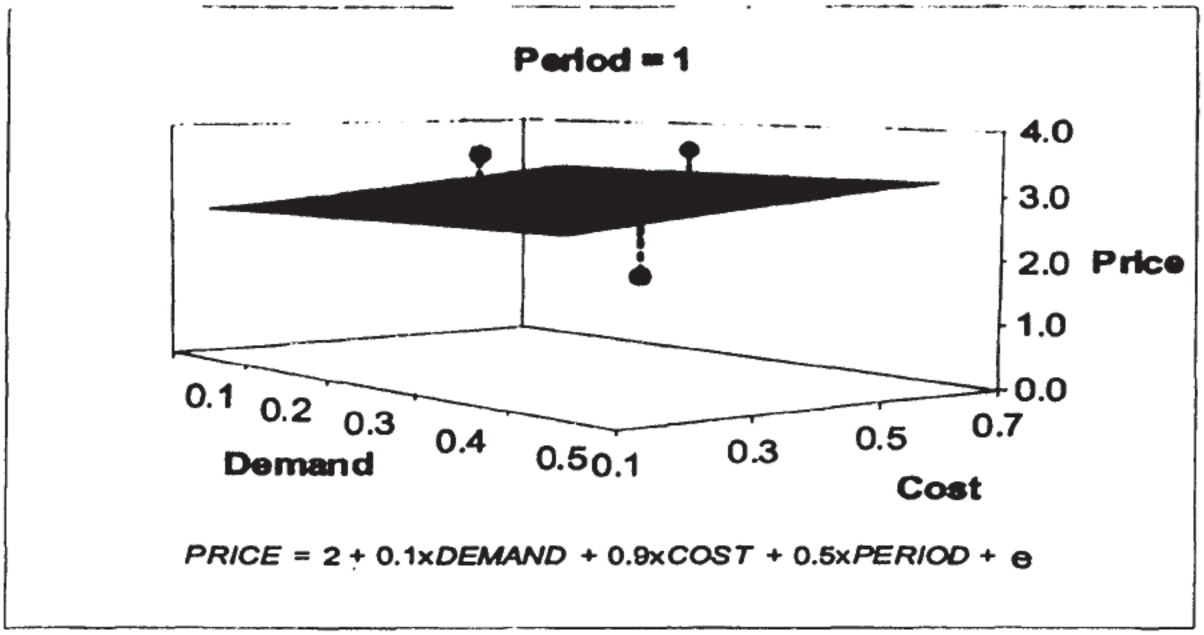

3. *Hypothesis Testing*

Hypothesis testing is the use of statistics to assess whether the data are consistent with a specified hypothesis.[53] Typically the hypothesis will be a statement about a coefficient. For example, the hypothesis may be that the coefficient on the PERIOD variable is equal to zero. The hypothesis test will consider whether the estimate of the PERIOD coefficient obtained from the data is consistent with what would be expected if in fact the PERIOD coefficient were zero. As mentioned above, the estimated coefficient for PERIOD likely would not be exactly equal to zero even if the true underlying coefficient were zero. However, the estimated coefficient should not be "far" from zero if the hypothesis were true.

Testing a hypothesis about a coefficient requires a measure of the *statistical precision* of the estimate of the coefficient. If there is a great deal of statistical noise so that a coefficient estimate is highly imprecise, it would provide relatively little information about the value of the true underlying coefficient.[54] As an example, an opinion poll based on a very small sample of respondents generally would not be very precise and thus would not provide a very useful estimate of what percentage of the

53. *See* GREENE, *supra* note 16, at 147.
54. *See* KENNEDY, *supra* note 29, at 67-68.

overall population held the opinion. A larger sample of respondents would produce a more precise estimate, but getting information from the entire population is not necessary to get a reasonably accurate estimate.

To measure the precision of a statistical estimate, econometricians and statisticians typically use what is called a *standard error*.[55] The standard error is best defined by explaining how it is used to create a *95 percent confidence interval*. A 95 percent confidence interval is approximately equal to the range defined by the coefficient estimate plus and minus two times the standard error. One can be "95 percent confident" that the true underlying coefficient lies within the appropriately defined 95 percent confidence interval. Economists often use 95 percent confidence intervals, but they also sometimes use intervals defined by lower or higher levels of confidence, such as 90 percent or 99 percent.[56]

When the coefficient estimate is relatively imprecise, the 95 percent confidence interval must be relatively wide to ensure that it includes the true value of the coefficient with 95 percent confidence. Conversely, when the coefficient estimate is relatively precise, the 95 percent confidence interval can be narrower.[57] Returning to the opinion poll example, pollsters often report the 95 percent confidence interval, e.g., "45 percent of respondents supported the proposal with a margin of error of +/- 5 percent." That is, the pollsters are 95 percent confident that the percentage of the population supporting the proposal is between 40 percent and 50 percent. The margin of error shrinks, all else equal, as the sample size of the poll increases and the precision of the poll increases accordingly. With a margin of error of +/-1 percent, the 95 percent confidence interval for the percentage of the population supporting the proposal would be narrower, from 44 percent to 46 percent.

Standard errors also can be used to conduct hypothesis tests regarding coefficients. Suppose the economist wishes to test the hypothesis that the coefficient on the PERIOD variable is equal to zero. To test this hypothesis, the economist would calculate the ratio of the coefficient estimate to its standard error, or "$\hat{\beta}/se(\hat{\beta})$" where $\hat{\beta}$ is the

55. *See* WOOLDRIDGE, *supra* note 3, at 41.
56. *See* GREENE, *supra* note 16, at 146.
57. *See* KENNEDY, *supra* note 29, at 54.

coefficient estimate and $se(\hat{\beta})$ is the standard error of the coefficient estimate. This ratio is called a *t-statistic*.[58]

If the hypothesis is correct and the true underlying coefficient is in fact zero, then the t-statistic should not be very far from zero. If the t-statistic turns out to be far from zero, it would cast doubt on the truth of the hypothesis. How do we determine whether the t-statistic is "far" from zero? We can calculate the probability that the t-statistic achieves a certain value, if the hypothesis were true. For example, if the hypothesis were true, there is about a 90 percent probability that the t-statistic will fall between 1.7 and -1.7 and about a 95 percent probability that the t-statistic will fall between 2 and -2. Thus, if the hypothesis were true, there would be only a 5 percent probability that the t-statistic we observe would be either greater than 2 or less than -2. Accordingly, if we observe a t-statistic greater than 2 or less than -2, the data would appear to be inconsistent with the hypothesis (because such an outcome is quite unlikely if the hypothesis were in fact true).

Indeed, if the absolute value of the t-statistic that the economist calculates exceeds two, then the hypothesis that the true underlying coefficient equals zero typically would be said to be *rejected* at the 5 percent significance level and the result typically would be termed *statistically significant*.[59] This result often is also expressed by saying that the coefficient is "statistically significantly different from zero (at the 5 percent level of significance)." The 5 percent level of significance (and the corresponding 95 percent confidence interval) is often used by economists and statisticians when conducting hypothesis tests, but other levels of significance, such as 1 percent or 10 percent, are also sometimes used.

As an example of these techniques of statistical inference, suppose that the coefficient estimate on the PERIOD variable in the price regression was 0.50, which would imply that prices were $0.50 higher during the alleged conspiracy period as compared to outside that period, holding constant the variables COST and DEMAND (and assuming correct model specification). Suppose further that the standard error of the coefficient estimate on PERIOD is 0.20. In this case, the 95 percent confidence interval would be approximately $0.10 to $0.90—one can be 95 percent confident that the true underlying coefficient on PERIOD lies

58. *See* GREENE, *supra* note 16, at 249.
59. *Id.*